

# Technology Innovation Project



*Project Brief*

## TIP 319: Multidimensional Learning on PMU Data for Event Detection, Characterization, and Prediction

### Context

In the emerging era of big data, machine learning techniques have become the de facto standard for processing and analyzing large amount of data, with little or no human involvement.

As BPA expands the number of deployed synchrophasors, it will be increasingly difficult to leverage the latent knowledge in this vast data stream without computational assistance. Data analysis and machine learning has proven to be the dominant technology in other data-intensive fields and we expect the power sector will follow a similar trend.

The project is an initial effort in this direction, aiming for converting synchrophasor data into valuable information effectively and at scale. This effort will enhance situation awareness and assist grid operators in making informed decisions.

### Description

This project aims to take techniques that have been successful in laboratory, proof-of-concept, or experiments typically performed with simulated data, and evaluate their performance in a large-scale, real-world setting.

The project examines historical records of BPA's synchrophasor (PMU) data to develop technologies in **event detection** to identify anomalies from the normal operation data; **event characterization** based on classification and clustering methodologies; **outcome prediction** using machine learning techniques to predict likely outcomes following an event; and **data cleansing** to detect erroneous data from the synchrophasor data stream and flag specific PMUs producing the error for replacement, calibration, or maintenance.

The outcomes of this project will be: (1) a suite of technologies for mining synchrophasor data to assist power grid operators' understanding of current operational status; and (2) a document outlining the strengths and weaknesses of different approaches for the tasks outlined that will help BPA guide future research and development.

Unlike other projects that target a single specific learning technology, our aim is to develop a useful software platform and in so doing to characterize the

strengths and weaknesses of a variety of potentially useful approaches that have been successful in small scale or proof-of-concept settings. Simultaneously, we will benchmark our approaches against hand crafted rule-based methods developed by domain experts.

### Why It Matters

As the first utility agency to implement a comprehensive adoption of synchrophasors in their wide-area monitoring system, BPA is in the right position to develop and deploy corresponding data analysis techniques for the synchrophasors. A successful deployment of synchrophasors along with effective data analysis technologies will also help BPA establish a leading role in smart grid field of tomorrow.

### Goals and Objectives

The goal of this two-year project is to develop event detection, classification, and outcome prediction methods for BPA's PMU data stream using machine learning techniques.

### Deliverables

The deliverables from the project will include set of software tools for mining the PMU data stream as well as the models obtained from learning on our data set. The project team will deliver a written project report along with existing software algorithms and experimental infrastructure. These digital artifacts will comprise a complete specification of our technology (source code, learned models, and experimental documentation). This specification could then be used by BPA as a prototype to guide the development of a full system for mission qualification and other uses beyond Technology Readiness Level 7.

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**Project Start Date:** October 1, 2014

**Project End Date:** September 20, 2016

### Reports & References (Optional)

### Links (Optional)

### Funding

Total Project Cost:	\$
BPA Share:	\$
External Share:	\$
BPA FY2015 Budget:	\$116,973

### For More Information Contact:

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### Participating Organizations

Washington State University, Vancouver WA

